Great credit is due, amongst others, to Mr. Walter Morrison, M.P., and to Messrs. John Birkbeck, Sen. and Jun., who have spared neither time, trouble, nor expense, and that in face of many discouragements.

R. H. TIDDEMAN

NOTES

THE belief in the safety of Dr. Livingstone caused by the telegrams which we published a fortnight ago, has been strengthened by further intelligence received since our last issue. The following telegram was to hand in London on Saturday last by the Falmouth, Gibraltar, and Malta Telegraph Company:—"Kirk reports from Zanzibar Livingstone safe at Unyanyembe. Visited north end of Tanganyika. Rivers said to flow into Lake Tanganyika. Stanley near the coast with letters. —GOVERNOR." No date is attached to the telegram; but at the meeting of the Royal Geographical Society on Monday evening, Sir Henry Rawlinson stated that he considered all doubt now to be removed, and that the intelligence now in hand is really authentic. He laid great stress on the well-known cautiousness of Dr. Kirk in receiving and communicating information respecting Dr. Livingstone. The following despatch from the Sultan of Zanzibar to Sir H. Rawlinson was read at the meeting:—"In the name of the Most Merciful God.—To our esteemed friend, Sir Henry Rawlinson. May the Almighty preserve him in health and happiness.—Your friend is quite well, and the object of our letter is to inform you that at the auspicious moment of our safe return from performing the pilgrimage to the holy cities of Mecca and Medina, my friend the Consul called on me and presented to me Lieutenant Dawson and his companion, and at the same time he delivered to me the letter from Her Majesty's Secretary of State for Foreign Affairs, Earl Granville, and also the gift presented by the Royal Geographical Society, through the President. And it has pleased me much to do that which is considered advisable, and that I am enabled to aid the people in their search for my friend Dr. Livingstone, and I pray God that certain information regarding him may soon be received, and I will give my aid to those gentlemen whom you have sent in attaining their object. And the Consul having requested me to grant the use of my steamer to the above gentlemen to convey them to Mombassa to procure men to accompany their expedition, I have done so, and, please God, I will continue to render assistance to those whom you have sent in your endeavour to explore the mysterious regions of the unknown country, because their object is praiseworthy, and tends to increase our knowledge of what the Almighty has created in these our countries.—From your friend, BURFASH BIN SAYYID.—Dated Zanzibar, the 5th day of Safr, year 1289 of Hejira, corresponding with the 14th April, 1872." Further telegraphic intelligence may be expected at any moment, and should this arrive we purpose next week to resume the present state of our knowledge respecting Dr. Livingstone's safety.

WE learn with great regret, from the scientific editor of *Harper's Weekly*, of the death of Dr. William Stimpson, late Secretary of the Academy of Sciences of Chicago. Dr. Stimpson's health has been quite precarious for several years past, making it necessary for him to proceed every winter to the warmer climate of Florida, and the past winter was spent by him in the same region. He was engaged in the earlier part of the season on board the United States Coast Survey steamer *Bache*, in superintending a series of dredgings, which, however, he was compelled to abandon through increasing ill-health, and returning not long since to the residence of his father-in-law, near Baltimore, he became gradually worse, and died there on the 26th of May. For a time a pupil of Prof. Agassiz at Cambridge, Dr. Stimpson made his first mark as a scientific author in 1851, in a work on the shells of New England, which was soon followed by a paper on the marine invertebrates of Grand Manan, published by the Smithsonian Institution in 1853, and which is still a standard work on the zoology of the mouth of the Bay of Fundy. Shortly afterwards he was appointed zoologist to the North Pacific Exploring Expedition, in which he was occupied for several years. When the late Mr. Robert Kennicott went to Alaska, in 1865, in the service of the Russian Telegraph Expedition, Dr. Stimpson moved to Chicago to take charge of the general affairs of the Chicago Academy of Sciences, and maintained that connection until his death. As a scientific investigator Dr. Stimpson occupied a very high rank for the thoroughness of his researches and the clearness and accuracy of his descriptions, in these respects leaving nothing to be desired. No one, with the exception, perhaps, of Prof. Dana, has described so many new species of marine animals as he. The detailed accounts of his new species, forming a large number of valuable zoological monographs, with large numbers of illustrations, and nearly ready for publication, were unfortunately all destroyed by the Chicago fire, together with most of the types of his species—a calamity which of course affected him severely, and in all probability materially influenced the state of his health. Among these works were synopses of the mollusca of the East coast of North America, and of the crustacea of both coasts, to be published by the Smithsonian Institution.

IT is rumoured that the dignity of K.C.B. is about to be conferred upon Mr. G. B. Airy, Astronomer Royal, and President of the Royal Society.

THE Albert medal of the Society of Arts has been awarded by the Council this year to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel." The Conversazione of the Society will be held on Wednesday, June 19, at the South Kensington Museum.

MR. CHAMBERS, F.R.S., Superintendent of Colaba Observatory, has been presented by the Bombay Harbour Board with a valuable gold watch and chain for his service towards the port in putting up a time ball.

THE examiners in the Natural Science School at Oxford, Dr. W. Ogle, Mr. R. H. Bosanquet, and Mr. A. W. Reinold, have issued the subjoined Class list:—Class I.: Henry Cooper, All Souls'; J. P. Earwaker, Merton; C. J. Moullin, Pembroke. Class II.: H. Green, Queen's College. Class III.: E. C. D. Fox, Exeter. Class IV.: J. A. Lloyd, St. John's.

THE following ladies have passed the examination for special certificates of higher proficiency at the University of London:—In Mathematics and Mechanical Philosophy, Mary Stewart Kilgour, Ladies' College, Cheltenham; in Geology and Palæontology, Laura Gertrude Eaton, Ladies' College, Cheltenham; in Political Economy, Jane Ellen Harrison, Ladies' College, Cheltenham; and in Harmony and Counterpoint, Mary Amelia Bennett, North London Collegiate School for Ladies.

PROF. HUMPHRY, F.R.S., will commence his Course of Three Lectures on Human Myology at the Royal College of Surgeons on Monday, June 17, at 4 P.M. They will be continued on Wednesday and Friday at the same hour. The lectures will discuss the morphology and teleology of the muscular system of man.

A TELEGRAM from Madras, printed in the *Times*, states that a court of inquiry is being held, with closed doors, on the conduct of Mr. Pogson, the Government Astronomer, who seems to be held responsible for the damage done by the late disastrous cyclone. Whether it is thought that he could have prevented the cyclone does not appear.

Reports have been received from Prof. Agassiz and his party on the *Hassler* up to the 18th of March, at which time they had reached the coast ot Patagonia. They were busily engaged in dredging and carrying on explorations along the shore, with a very fair measure of success. The details have not yet been announced, but we trust we shall have an opportunity before long of presenting these to our readers.

The Annual Report of the Trustees of the Museum of Comparative Zoology at Cambridge, U.S.A., for 1871, has made its appearance, and presents the usual satisfactory account of progress in the preceding twelve months. No institution of the kind in America, and few anywhere, has so extensive and thoroughly organised a corps of scientific assistants (amounting to between thirty and forty) as that at Cambridge; and, with the immense amount of material constantly coming in, the result in greater part of Prof. Agassiz's indefatigable personal labours, supplemented by purchases of entire collections, it is not to be wondered at that the museum is rapidly occupying the foremost rank among such establishments. Prof. Agassiz, the director, calls attention to his expected absence from the country in the expedition of the *Hassler*, gives an account of the arrangements made temporarily to supply his place, and presents the special reports of the various assistants upon the work accomplished in 1871, and to be continued during the year 1872.

Among the more interesting collections lately received by the Smithsonian Institution at Washington, in the department of ethnology, is a mummied human head, retaining all the form and features of life, including hair, lips, &c., but reduced by some peculiar process so as not to exceed the size of an ordinary fist. These heads are found among the Javaro tribes in the province of Chimborazo, in Peru, and are said to be of great antiquity, there being no indication of recent preparation. They are believed to be the heads of enemies slain in battle, and preserved in this way as trophies of victory. The interior of the head has been entirely emptied of flesh, bones, and brain; and the skin, which alone remains, by its contraction is thickened to the amount of more than an eighth of an inch. The lips are closely compressed, and through them are strung a series of knotted cords, which in their character call to mind the guipos of the ancient Peruvians. There is also a cord which is knotted inside the top of the head, by which it is suspended. No satisfactory explanation of the mode of preparation has been given, although there is a tradition that it is effected by introducing heated stones or sand into the cavity after the removal of the portions of the head referred to.

The Transactions of the Norfolk and Norwich Naturalists' Society for 1871-72 show evidence of good work being done by its members. The president, in his address, speaks of the satisfactory progress made in the important task which the Society has in hand, of compiling well-authenticated, and, as far as possible, complete lists of the fauna and flora of the county; and the following papers are printed in the Report—some of them, although referring to local subjects, of more than local interest:—"On the Occurrence of the Ringed or Marbled Seal (*Phoca hispida*) on the Norfolk Coast," by T. Southwell; "Scoulton Gullery," by H. Stevenson; "The Norfolk Broads and Meres Geologically Considered," by J. E. Taylor; "Further Notes on Coast Insects found at Brandon," by C. G. Barrett; "The Marine Mollusca of the Norfolk Coast," by F. W. Harmer; "A List of Land and Freshwater Shells found in Norfolk," by J. B. Bridgman; and "On the Spongeous Origin of Flints," by F. Kitton.

We have received from the Royal Cornwall Polytechnic Society, Falmouth, a list of a large number of subjects in which prizes and premiums will be awarded in the course of the present season. The fortieth Annual Exhibition of this Society will open on Wednesday, August 21. Medals and prizes in money will be awarded in the following Departments:—Mechanics—Machinery and Models; Mechanical and other Scientific Inventions and Improvements; Specimens of Naval Architecture; Essays and Scientific Papers, &c. Fine Arts—Pictures and Drawings by Professional Artists and Amateurs, Sculpture, Architectural Drawings and Models, and Specimens of Ornamental Art. Photography—Photographs by Professionals and Amateurs. Natural History—Essays, Local Observations, Collections of Specimens, &c. School Productions—Mechanical and Freehand Drawings, Specimens of Penmanship, &c. Plain Needlework, &c., British Lace, and all objects of interest connected with Science and the Fine and Industrial Arts, which may be considered deserving by the Judges. List of Prizes and Premiums, and all further information, may be obtained from the Secretary, J. H. Collins, F.G.S., Polytechnic Hall, Falmouth.

Science and Art teaching seems to be flourishing in Plymouth, if we may judge from the number of papers worked at this year's examinations (just concluded) by the students of the Charles Science and Art Schools. Three hundred and thirty papers have been sent up in the various subjects, being an increase over 1871 of fifty-six papers, or 20 per cent. Owing to the Department holding the examinations in several subjects in one evening, students are prevented from being examined in more than one of these, which will, in most cases, account for the falling off in those few cases where there is a decrease.

Mr. N. Von Maclay, who is in charge of a Russian scientific exploration of the Atlantic and Pacific oceans, reports to the Academy of Sciences of St. Petersburg that on the passage of the *Witjas* from the Cape de Verde Islands to Rio he made an experiment on the 3rd of February for the purpose of determining the temperature of the sea at a depth of 1,000 fathoms in the region of calms, about 3° north latitude and 24° west longitude. The temperature of the water at this depth was 38·30° F., that of the surface water being 81·68° F. It is interesting to compare this with the temperature obtained during the past winter by the Coast Survey steamer *Bache*, at about the same depth, in the deep water between Cuba and Yucatan, in the latter case the temperature amounting to about 39·50° F.

It seems almost impossible to exhaust the richness of the deposits of vertebrate fossils of the Western territories of the United States, Prof. Leidy having lately added to the number by the description of two extinct tapir-like animals, one about the size of a raccoon, and the other about the size of a rabbit, and an insectivorous animal of the dimensions of the hedgehog. The are from the tertiary formation of Wyoming Territory.

Harper's Weekly notes that a remarkable fact connected with the interchange of animal species between Europe and America is seen in the frequency with which North American birds occur in England, and the scarcity of European birds in America. Nearly seventy species of the birds characteristic of the American fauna have so far been detected in Great Britain, the latest announcement of this kind being that of the black-billed cuckoo, which was taken at the end of September 1871 in Antrim, ten miles from Belfast. Very few of the European land birds have been found in North America, with the exception of a few species that are really Arctic in their distribution, although less frequently seen in the New World than in the Old. The water-birds of Europe are more common as stragglers. Among them we may mention the English green-winged teal, the widgeon, the woodcock, &c. The entire list, however, does not amount to a dozen species. The causes of this difference are doubtless to be met with in the comparative prevalence of certain winds. Most of the captures of American species take place in Ireland in autumn and early winter, and in all cases are species belonging to the northern portion of America which migrate southward at the close of the breeding season. At that time the prevailing winds are from the west, and the birds in their flight become confused, and are carried across by the winds, taking an occasional rest on passing vessels.

MR. J. COBBIN, of Durban, forwards to the *Natal Colonist* the following account of a "sea-serpent" seen by him:—"During my late passage from London, I saw no less than three sea-serpents, but an account of the last will suffice. On 30th December last, on board the *Silvery Wave,* in lat. about 35′ 0″ S., and long. 33′ 30″ E., at 6.20 P.M. solar time, an enormous serpent passing nearly across our bows compelled the alteration of our course. He was at least one thousand yards long, of which about one-third appeared on the surface of the water at every stroke of his enormous fan-shaped tail, with which he propelled himself, raising it high above the waves, and arching his back like a land-snake or a caterpillar. In shape and proportion he much resembled the cobra, being marked by the same knotty and swollen protuberance at the back of the head on the neck. The latter was the thickest part of the serpent. His head was like a bull's in shape, his eyes large and glowing, his ears had circular tips and were level with his eyes, and his head was surmounted by a horny crest, which he erected and depressed at pleasure. He swam with great rapidity and lashed the sea into a foam, like breakers dashing over jagged rocks. The sun shone brightly upon him; and with a good glass I saw his overlapping scales open and shut with every arch of his sinuous back coloured like the rainbow."

ABNORMAL DISPERSION OF BODIES WITH SURFACE-COLOURS.[*]

THESE memoirs relate to the abnormal phenomena of dispersion produced by certain bodies which reflect the rays of some colours in the manner of transparent media, and those of other colours in the manner of metals.

In transparent bodies the velocity of light is less than in a vacuum, and the index of refraction increases as the length of undulation diminishes, whereas, in the case of metallic bodies, theory leads to essentially different results. From the researches of Jamin on the elliptic polarisation of light reflected by metals, and from the more recent experiments of Quincke, it appears that the formulæ of Cauchy, Beer, and Eisenlohr give for certain metals, as gold and silver, an index of refraction less than unity, whence it follows that in these metals the velocity of light is greater than in the vacuum. Cauchy's theorem, verified by the experiments of Jamin, likewise shows that the index of refraction in metals varies with the angle of incidence, and that in most metals dispersion takes place in a manner opposite to that which occurs in transparent bodies, that is to say, that the rays of shortest wave-length are less refracted than those whose undulations are longer.

The only physicist who has hitherto attempted a direct verification of these theoretical results is Quincke; but his experiments have yielded contradictory results according to the method employed, and have therefore afforded no decisive information as to the indices of refraction and dispersion of metals. Kundt, in studying the properties of a particular class of bodies which approach the metals in their optical properties, has succeeded, if not in determining the absolute values of their refractive indices, at least in observing certain anomalous phenomena of dispersion, which appear to indicate the direct road towards a new verification of the theoretical formulæ.

The bodies in question are media intermediate between transparent bodies and metals, inasmuch as they behave like metals towards rays of certain colours, and like transparent bodies towards rays of other colours; they also reflect light with a certain degree of metallic lustre. These substances may be included under the denomination of *bodies with surface-colours.* Most (but not all) of them are strongly tinctorial, and exhibit, both in solution and in small fragments, a beautiful coloured transparency; such are most of the aniline-dyes, indigo, carthamine, potassium-permanganate, &c.

The optical properties of these bodies have been studied by Brewster, Haidinger, Stokes, and several others, the chief result of whose researches is the law, first enumerated by Haidinger, that the light transmitted by these media is exactly or nearly complementary to the light reflected from their surfaces, and, therefore, to the colour of the surface. Moreover, Dale and Baden Powell observed that indigo and Prussian blue, in reflecting light, polarise it elliptically, like the metals; and von der Willigen determined the reflection-constants of pale indigo, and found that the principal angle of incidence diminishes from the line B to E, and then increases from E to G.

The author's views respecting these bodies are based on the hypothesis that they exhibit the most general case of dispersion, that, namely, in which the index of refraction may not only increase or diminish when the wave-length in air diminishes, but may even become less than unity.

The examination of the light reflected by these bodies is alone sufficient to lead to this hypothesis. For when a medium is transparent for a particular ray, the intensity of the reflected light is expressed by the formula $\left(\frac{n-1}{n+1}\right)^2$, the value of which increases or diminishes with the increase of n, according as n is greater or less than unity. In most transparent bodies the variation of n for the different colours,—that is to say, the dispersion—is so small, that the whole of the reflected light exhibits the same colour as the incident light, so that, if the incident light is white, the reflected light is white also. Applying this formula to bodies with surface-colours, it would follow that the rays which form the superficial colour, that is to say, those which are reflected in very great proportion, should have, relatively to the others, a very large or very small index of refraction.

As the rays which form the surface-colour may have any wave-length whatever, it would follow from the formula which gives the intensity, that the dispersion of bodies with surface-colours should be, or at least might be, abnormal, in a manner which is perfectly arbitrary. It might even happen that a portion of the transmitted rays, if made to pass with a sufficient intensity through a prism of the substance, would be refracted on one side of the direction of the incident rays, and the rest on the other side. In fact, for rays which are reflected in large proportion, that is to say, rays for which the bodies under consideration act like metals, the preceding formula is not applicable, and it is necessary to employ the formulæ given by Cauchy, in his theory of metallic reflection.

These formulæ give, for the normal incidence:

$$I = \tan\left(\psi - \frac{\pi}{4}\right)$$

where ψ is determined by the relation

$$\cot\psi = \cos\epsilon \sin 2 \tan^{-1}\theta,$$

ϵ and θ being two constants to be determined by experiment, according to the relations—

$$\theta\cos\epsilon = n\,;\quad \theta\sin\epsilon = \gamma,$$

n being the index of refraction, and γ the coefficient of extinction under the normal incidence.

According to these formulæ it is not absolutely necessary, as remarked by Cauchy, that the index of refraction of metals should be very large. Nevertheless it appears from the experiments of Jamin, and those more recently made by Quincke, that the constants of elliptic polarisation have values which indicate for most metals a very large refractive index, and for silver and gold an index less than unity.

Cauchy's formulæ, applied to bodies with surface-colours—admitting that the elliptic polarisation produced by these bodies is analogous to that produced by the metals—renders probable the existence of refractive indices either very large or less than unity: hence the probability of abnormal dispersion resulting from transmission through these bodies.

When one of these surface-coloured bodies is dissolved, it preserves in solution its abnormal properties relatively to dispersion. This abnormal dispersion will be combined with the

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[*] By A. Kundt (Pogg. Ann., cxlii. 177; Journal de Physique, 1872, p. 38) nd J. L. Soret (Pogg. Ann., cxliii. 325; Journal de Physique, 1872, p. 45).